Geotechnical Investigation Report
Proposed Planned Development
7845 NE 122nd Place
Kirkland, Washington

Project 1794-01
January 28, 2015

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1.0 INTRODUCTION

The Galli Group performed a geotechnical investigation on the property located at 7845 NE 122nd Place, Kirkland, Washington. The purpose of our investigation was to identify the subsurface soil and groundwater conditions and to provide recommendations for site development and foundation support.

This geotechnical report summarizes observations from our research and subsurface exploration performed for the above referenced property. It also presents our recommendations for the geotechnical design elements of the project.

2.0 PROJECT DESCRIPTION

The project site is located on the south side of NE 122nd Place easterly from the intersection with NE Juanita Drive in Kirkland (see Figure 1, Vicinity Map). The parcel is accessed from a gravel driveway off of NE 122nd Place. The property is separated from the road by a small creek located at the southerly toe of the embankment fill forming NE 122nd Place and at the northerly toe of the slope on the north side of the parcel. The slopes of the roadway embankment and the north facing slope of the parcel appear inclined at about 22 to 40 percent. The height of the roadway embankment varies from a few feet at the west end of the parcel to about 14 feet at the eastern end of the parcel. Similarly the height of the slope on the property varies from almost nothing to about 12 feet at the eastern end of the parcel (see Figure 2, Site Exploration Plan).

The approximately one acre site currently contains a single family residence and several outbuildings. Public water and sewer are available to the site form NE 122nd Place.

We understand that proposed improvements include construction of a ten-unit planned development clustered on the upper portion of the parcel maintaining the setbacks and buffers required for the creek. The units will be accessed by a roadway from NE 122nd Place that crosses the creek on an embankment fill with a large culvert across the stream (see Figure 3, Preliminary Site Plan). The units will be constructed as wood-framed houses on conventional spread footings. Utilities will be brought to the units by means of the new roadway or overhead lines.

3.0 GEOLOGIC HAZARDS DISCUSSION

3.1 GEOLOGIC HAZARDS AND CODE REQUIREMENTS

We reviewed the Kirkland Zoning Code (KZC) to see if the site might be governed by Geologically Hazardous Areas regulations (KZC Chapter 85). In particular, the site likely contains erosion hazard areas, and includes natural slopes that meet the definition of moderate landslide hazard areas. A portion of the slope might exceed 40 percent near the northeast corner of the parcel. In the sections below we discuss and conclude that the site does not contain seismic hazard areas. Below we have discussed the elements that apply to the project site with reference to KZC Geologic Hazard requirements.

3.1.1 Erosion Hazard Areas

The KZC defines Erosion Hazard Areas as the following (KZC 85.13.2)

> "Areas containing soils which according to the USDA Soil Conservation Service King County Soil Survey dated 1973, may experience severe to very severe erosion hazard...when they occur on slopes of 15 percent or greater."

The existing north facing slope is inclined at about 22 percent to almost 40 percent. Above the slope on the upland portion planned for dwelling units, the site is currently inclined at less than 5 percent. The Soil Conservation Service maps the area as underlain entirely by Alderwood gravelly sandy loam material. These soil formations are comprised of glacially consolidated drift and outwash deposits, which have weathered over the last ten thousand years. The map unit is described as having a "moderate" erosion hazard.

Because of these topographic and soil conditions the project site will be designated an Erosion Hazard Area. However, the site evidenced no signs of concentrated discharges, or surficial erosion that we were able to find. Conventional BMPs should be adequate to prevent erosion, sediment transport, and slope incision during construction. Permanent vegetative cover and stormwater runoff control should adequately reduce long term risks of erosion.

3.1.2 Landslide Hazard Areas

The inclination of the slope on the north side of the lot was measured at about 22 to 40 percent and was about 10 to 12 feet in maximum vertical height. Based upon evidence from our subsurface exploration, the steep embankments appear comprised of very dense glacial till blanketed by two to three feet of weathered till and topsoil.

Chapter 85.13.4 of the KZC defines "Landslide Hazard Areas" as follows:

> "High Landslide Hazard Areas – Areas sloping 40 percent or greater, areas subject to previous landslide activities and areas sloping between 15 percent and 40 percent with zones of emergent groundwater or underlain by or embedded with impermeable silts or clays."

> "Moderate Landslide Hazard Areas – Areas sloping between 15 percent and 40 percent and underlain by relatively permeable soils consisting largely of sand and gravel or highly competent glacial till.

Geologic maps of the area indicate that the site is likely underlain by glacial till deposits (*Geologic Map of the Kirkland Quadrangle, King County, Washington*, James P. Minard, 1983). A portion of the geologic map is provided on Figure 4, Geologic Map. Glacial till generally consists of unsorted mixtures of silt, sand, clay and gravel pushed over the existing landscape under and around the advancing glacier thousands of years ago. The material was subsequently overridden by tons of ice densely compacting it into a very dense consistency. It is noted for its extreme density, relative impermeability, excellent foundation support, and ability to stand nearly vertical in unsupported relief. It also tends to form a downward barrier to surface water infiltration, perching near surface flows below the weathered zone.

Mitigation measures for the steep slopes should address the preservation of vegetation, and should provide for stabilization of the surface of embankment fill. Mitigation measures during construction should also address the potential of perched seepage zones appearing at or near the contact with the dense glacial till beneath the weathered zone.

3.1.3 Seismic Hazard Area

Seismic hazard areas are defined as:

> "Those areas subject to severe risk of earthquake damage as a result of seismically induced settlement or soil liquefaction, which conditions occur in areas underlain by cohesionless soil of low density usually in association with shallow groundwater table. (KZC 85.13.5)

The project site appears underlain by dense glacially consolidated soil, or glacial till at depth and does not appear to have a permanent shallow groundwater table. This dense material does not present a risk of deep-seated slope movement or seismic liquefaction. Provided the new foundations are supported on native undisturbed soil, the risk of seismic-induced settlement does not appear significant. In our opinion the site does not represent a severe risk of damage due to seismic induced ground shaking.

In the report sections that follow we have described the site soil conditions and the subsurface geologic conditions. The site appears underlain by dense glacially consolidated sediment blanketed by about 2 to 3 feet of weathered silty SAND and topsoil or forest duff. The project site is positioned on a north facing slope inclined at about 22 to 40 percent overall but with heights limited to less than 12 feet. The slope of the site presents risks of erosion during construction and following construction unless stormwater discharge is adequately handled. The site does not appear to present significant risk of landslides. In our opinion it does not present a significant risk of seismic liquefaction, landslides, or erosion if conventional Best

Management Practices are followed during site improvements, and our recommendations are followed during project development.

3.2 EROSION AND SLOPE MITIGATION MEASURES

The proposed project site and slope appears underlain by very dense glacial till, mantled by weathered till and topsoil. Small amounts of fill (less than 18 inches thick) have been pushed over the upland area of the site to flatten out the existing yard. Perched near surface seepage was evident in most of the test pits but particularly on the lower reaches of the north facing slope and the south side of the upland area. In order to prevent adversely impacting the slope, adjacent properties, or increasing the risk of erosion and sediment transport we recommend the following mitigation measures.

1. Prior to placing any embankment fill for the culvert crossing, the slope should be grubbed and benched so that new fill may be placed and compacted against horizontal surfaces. This will aid in compaction and reduce the likelihood of movement of the added fill.
2. Where compacted embankment slopes are constructed they should be flattened to no steeper than 2H:1V, or protected with engineered retaining walls designed to create terraced slope conditions. Fill slopes should be protected with erosion control mats during the wet season and properly amended, vegetated, and mulched prior to project completion. Embankment slopes should be protected by a landscape plan that will permanently stabilize the slopes and the site against surficial erosion.
3. Where possible we recommend maintaining and preserving or replacing significant trees whose function appears to reduce site runoff and stabilize steeper slopes.
4. Conventional BMPs discussed in sections below should be employed during construction to control sediment transport and limit construction erosion.
5. Due to the amount of embankment fill and site grading anticipated we recommend conducting grading activities during the drier season to limit erosion, and save costs.

Provided the recommendations in our report below are followed during design and construction it is our opinion that the proposed project may safely be constructed on the site and in keeping with the Kirkland Zoning Code regulations related to geologically hazardous areas.

4.0 SITE FEATURES

4.1 SURFACE CONDITIONS AND GEOLOGY

The upland portion of the site descends from the eastern boundary toward the western end of the parcel at an overall declination of 5 percent. The upland portion is covered with lawn and a few ornamental trees. Portions of the upland area appear to have been re-graded to flatten out the site resulting in layers of about 12 to 18 inches of fill overlying the original topsoil in some locations. The lower reaches of the site in the vicinity of the existing driveway entrance was much flatter and wetter than the rest of the site. It appeared that the creek might occasionally overtop the 12-inch culvert during extreme runoff events.

The north facing slope descends toward the creek at a declination of about 22 percent to about 40 percent near the northeasternmost corner of the lot. The height of the slope is generally less than 12 feet. The existing north facing slope is vegetated with mature Douglas Fir, Cedar, Maple, and Alder trees with understory ferns, blackberries, and thick forest litter. We did not observe any indications of slope movement or erosion. The creek at the toe of the slope has incised the bank by about 18 to 24 inches. Bank incision did not appear rapid or severe. The slope appeared stable at the time of our site visit.

Geologic maps of the area indicate that site is likely underlain by glacial till (*Geologic Map of the Kirkland Quadrangle, Washington*, James P. Minard, 1983). Glacial till generally consists of unsorted mixtures of silt, sand, clay and gravel, pushed over the existing landscape by the advancing glacier thousands of years ago. The material was then densely consolidated by tons of ice. Glacial till is noted for its very dense consistency, ability to stand nearly vertical in unsupported relief, relative impermeability, and excellent foundation support. It appears stable in slopes but can become unworkable when wet due to the high silt content. Often the unweathered till serves as a downward barrier to stormwater runoff and infiltration, creating a perched layer along the top of the dense soil within a few feet of the surface.

4.2 SITE SOIL AND GROUNDWATER CONDITIONS

On January 23, 2015, we conducted a subsurface exploration on the site to identify the underlying soil conditions in the vicinity of the proposed dwelling units and near the proposed culvert crossing. We excavated one test pit adjacent to the creek near the proposed crossing, supplemented by a hand hole on the opposite side of the creek (TP-1 and HH-1). We also excavated five additional test pits (TP-2 to TP-6) on the upland portion of the lot surrounding the proposed dwelling units. A geotechnical engineer identified the soil in the field and estimated the density of the soil in the test pits at varying depths. The locations of the test pits are provided on Figure 2, Site Exploration Plan; a scaled plan of the upland area is provided behind Figure 2. A profile of the existing soil stratigraphy is provided on Figure 5, Cross Section. The details of our subsurface exploration are provided on the test pit logs in the attached Appendix.

Based upon our subsurface exploration the site appears underlain by a unit of very dense silty SAND with gravel throughout the site. We interpreted this unit as native undisturbed glacial till. The dense till was consistently mantled by a layer of weathered silty SAND and topsoil or forest duff that was about 18 to 30 inches thick. In some locations undocumented fill had been pushed over the topsoil adding to the thickness of the overlying soil. We encountered seepage in all test pits except TP-2 and TP-6. Seepage was especially rapid near the south side of the upland area (estimated at about 5gpm initially then decreasing to less than 1 gpm).

Based upon our subsurface investigation it appears that the excavation depths for conventional footings will be on the order of about 2½ to 3 feet deep to support the footings in the native dense glacial till. Groundwater seepage should be anticipated in most of the excavations. Removal of the collected water by sumps and pumps should be sufficient to handle the seepage. Temporary excavations exceeding 4 feet would likely have to be laid back at about 1H:1V to avoid caving or loss of material into excavations.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The site appears underlain by a unit of native glacial till consisting of dense silty SAND with gravel. The dense soil was mantled by a layer of weathered silty SAND and topsoil. We anticipate that native dense glacial till deposits will be encountered at depths from 2 to 3 feet in most locations on the site. We did not see any evidence of slope movement on the site. We anticipate that the proposed structures can be supported on conventional spread footings founded in the native undisturbed glacial till. Seepage should be expected in most excavations at the contact with the underlying dense glacial till unit, especially during the wetter months. In the report sections that follow we have addressed the following geotechnical elements:

- The culvert should be supported on dense undisturbed glacial till
- Conventional BMPs discussed in sections below should be employed during construction to control sediment transport and limit construction erosion.
- Embankment slopes should be protected by a landscape plan that will permanently stabilize the slopes and site against erosion.
- Where possible we recommend maintaining and preserving or replacing significant trees whose function appears to reduce site runoff and stabilize embankment slopes.

5.1 SITE GRADING AND EARTHWORK

Site development will result in an excavation footprint exposing medium dense to dense silty SAND. Best Management Practices commonly observed should be employed during construction. We anticipate these will include the following:

1. A construction entrance should be provided for the site and to act as a staging area for construction materials. The entrance should be constructed from 4” – 6” quarry spalls.

We recommend locating the construction entrance near the existing entrance supplemented by additional quarry spalls and bordered by silt fencing and possibly improving drainage under the entrance where the existing concrete culvert appears partially obstructed.

2. It is important to avoid tracking sediment onto the roadway. The contractor should monitor the tracking of sediment from the site and clean up as necessary. Sand and silt tracked from the site should be removed or cleaned by the contractor. If tracking onto the roadway becomes a problem, the contractor will need to construct a wheel-wash area on site for vehicles leaving the site.
3. A silt fence should be erected along the lower limits of areas disturbed by grading activity. Significant trees marked for preservation should be protected with highly visible fencing.
4. Collected stormwater runoff or seepage can be handled by a system of sumps and trenches within the excavation and discharged to a vegetated area of the site.
5. Spoils should be removed immediately from the site or protected during wet weather by use of plastic sheeting. Generally stockpiles should not remain uncovered for more than 2 days during the wet season or 5 days during the drier summer months. Site soils if kept dry, might be suitable for backfill behind foundations and stem walls excepting drainage zones indicated on drawing details.
6. The contractor should monitor the performance of the erosion control measures and contact the geotechnical engineer if the TESC measures do not provide the intended function.

5.2 TEMPORARY EXCAVATIONS AND GRADING

5.2.1 Unsupported Excavations

Temporary excavations should be shaped or benched to protect workers below. As a general rule temporary construction cuts exceeding 4 feet in height within the site soils should be inclined no greater than 1H:1V(Horizontal to Vertical). Once cuts are exposed, the soils must be protected from wet weather.

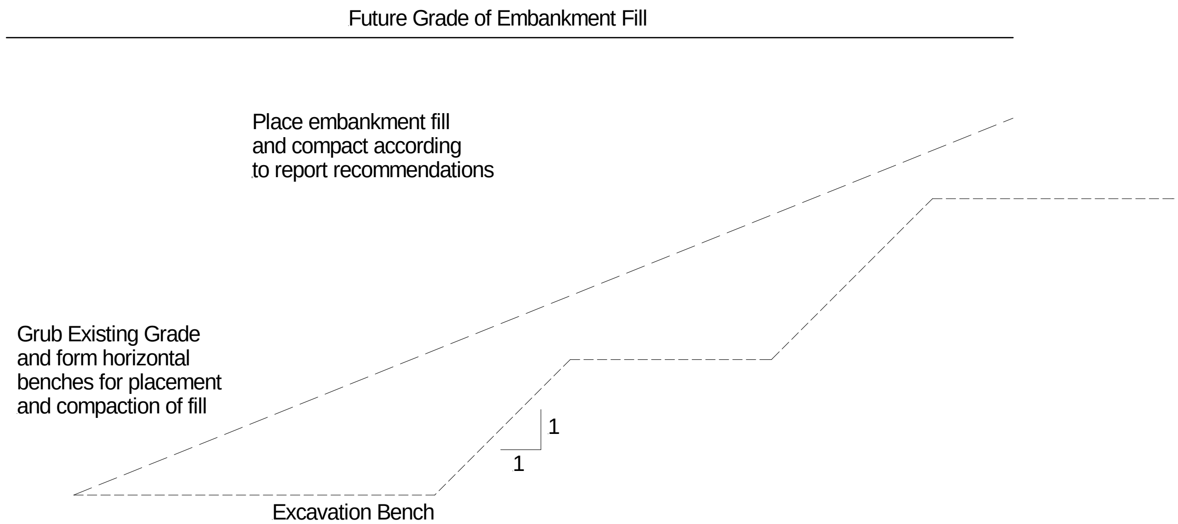
Where temporary cuts are not able to be utilized due to lateral constraints, additional measures such as ecology blocks or other temporary shoring might be required. The cuts may not be oversteepened without approval from the geotechnical engineer. Maintaining safe open excavations for workers and protecting the exposed cuts shall be the ongoing responsibility of the contractor.

5.2.2 Preparation of Slope for Roadway Embankment Fill

Preparation of the slope for embankment fill should begin by grubbing the area to remove all organic material and organic-rich soil. The slope should be shaped into horizontal benches as illustrated below so that imported fill may be placed and compacted against horizontal surfaces.

Permanent embankment slopes for areas such as the culvert crossing should be placed and compacted according the recommendations provided in report sections to follow.

If there is a significant delay between construction of the embankment fill and final landscaping then we recommend using erosion control mats such as C125 by North American Green to protect the slope surface until final vegetation can stabilize the surface.



Temporary Excavation Schematic

If the design team elects to construct retained roadway fill, the design of the walls should be in accordance with the recommendations provided below.

5.3 LATERAL EARTH PRESSURES AND RETAINING WALLS

The proposed project might incorporate retaining elements. These include possible roadway retaining walls, geogrid reinforced block walls, or cantilevered retaining walls.

The table below provides soil parameters used in the analyses for this project.

Table 1

Soil design parameters used in determination of lateral earth pressures

Soil Type	Unit Weight γ, pcf	Passive Resistance (EFW)	Active Earth Pressure (EFW)	At-Rest Earth Pressure (EFW)	Inclined Slope Condition
Dense silty SAND	125	300 pcf	35 pcf	60 pcf	60 pcf
Compacted Fill	125	300 pcf	35 pcf	60 pcf	NA

(EFW) = Equivalent Fluid unit Weight in pounds per cubic foot

For the conventional concrete walls, we recommend the following:

1. Excavation for the walls must be accomplished in accordance with the recommendations supplied in section 5.2 above. The excavation should be benched so that compaction of backfill may take place against horizontal soil surfaces.
2. All walls must be supported on native undisturbed soil. We recommend using an allowable bearing capacity of 3000 psf for design of footings supported on the native undisturbed dense glacial till.
3. The walls should be designed to resist an active earth pressure equivalent to 35 pcf per foot of retained soil height. This assumes level drained backfill. Wall backslopes must not exceed 3H:1V. Walls with backslopes should be designed using 60 pcf active earth pressure.
4. For braced walls or restrained walls, a lateral at-rest earth pressure of 60 pcf should be used for design of the walls.
5. A uniform load equivalent to 10H where H is the retained height of the wall, may be used to calculate the lateral load contributed by seismic induced ground acceleration.
6. Lateral resistance for retaining walls may be calculated at 300 pcf per foot of overburden. The contribution from the uppermost 12 inches of soil should be ignored.
7. A backwall drainage system must be supplied for all newly constructed walls. The drainage system shall include at a minimum, a 4-inch perforated, smooth-walled pipe, enveloped in ¾” to 1½” washed gravel, and wrapped in Mirafi 140N filter fabric for separation from adjacent soils. The footing drains may be directed to a suitable discharge point on site.
8. Backfill placed behind the wall should be placed and compacted in thin enough lifts to achieve the compaction criteria listed in the report sections below.
9. The geotechnical engineer should verify that the drainage system, bearing conditions, and backfill compaction are in accordance with the report recommendations.

5.4 FOUNDATIONS

Foundations for the buildings will consist of spread footings supported on the undisturbed silty SAND (glacial till) unit. We anticipate that this unit will be encountered at depths on the order of two to three feet below existing grade.

5.4.1 Seismic Design Parameters

The site is underlain by glacially consolidated sediment. Based upon the density of the underlying soil we do not think seismic liquefaction or lateral spreading will be a significant risk factor to site development. We recommend using site Class D for this project site.

5.4.2 Spread Footings and Wall Footings for Dwelling Units

Column or wall loads within the excavation footprint may be supported on spread footings. For spread footings within the excavation we recommend the following:

1. An allowable bearing pressure of 3000 psf may be used for footings bearing on undisturbed glacial soil. This may be increased by 1/3 for temporary loads such as wind loads or seismic loads.
2. The passive resistance for the footings may be calculated at 300 psf in the native soil.
3. A coefficient of friction of 0.4 may be used for the interface between the bottom of the footing and the soil.
4. The footing area must be free from loose or wet soil prior to placing reinforcing or pouring concrete. The geotechnical engineer should verify the bearing.
5. Perimeter footing drains should be provided around all footings and discharge to daylight, a dry well, or to an approved storm drain.

Deck or porch footings should bear on native undisturbed soils to avoid settlement. These can be provided by pouring a footing and bringing the support to grade using a concrete pier.

To preserve the design values for allowable bearing we recommend the following on the perimeter footings and column footings where wet soil conditions from seepage are encountered:

- If the excavation cannot be dried out by use of pumps and sumps and the soil surface appears to "pump" or lose strength, then we recommend the contractor excavate the footings to 6 inches below design grade using a bucket with no teeth. Immediately place a 4-6" layer of the 1¼" clean crushed rock on the subgrade to protect the bearing surface from seepage and foot traffic.
- Compact the rock briefly under geotechnical observation to a smooth uniform surface using a plate compactor. Avoid compaction if the soil begins to pump.
- Provide a route to direct seepage water around and away from the footing zone to a sump where the water can be collected and removed from the excavation by pumping.

5.4.3 Spread Footings for Culvert Support

Dense, undisturbed glacial till was evident at about 3 feet below existing grade on either side of the creek in the vicinity of the proposed culvert and road crossing. The culvert should be supported on conventional spread footings founded within the dense glacial till. We recommend the following for the culvert footings:

1. An allowable bearing pressure of 3000 psf may be used for culvert or headwall footings bearing on undisturbed glacial soil. This may be increased by 1/3 for temporary loads such as wind loads or seismic loads.
2. The passive resistance for the footings may be calculated at 300 psf in the native soil. Passive resistance between the creek and the footing should be ignored.

3. A coefficient of friction of 0.4 may be used for the interface between the bottom of the footing and the soil.
4. Seepage at the contact between the looser soil unit and the underlying dense silty SAND should be collected and discharged to a suitable vegetated area at least 25 feet from the creek. The discharge areas should be bounded by a silt fence or straw wattles on the downhill side.
5. The footing area must be free from loose or wet soil prior to placing reinforcing or pouring concrete. The geotechnical engineer should verify the bearing.
6. We recommend pouring the footings neat against the soil to help preserve the bearing surface and to reduce the risk of scour in the footing area.

5.5 SLAB-ON-GRADE FLOORS

The sections below provide recommendations for typical slab construction and also for a concrete slabs where there is evidence of seepage and wet ground conditions. The section for the wet conditions adds an additional “drainage blanket” beneath the slab.

5.5.1 Recommendations for Typical Concrete Slab

Reinforced concrete floors which are beneath structures ringed with perimeter footings or walls can be supported on a 4-inch drain rock layer placed over properly prepared subgrade or granular fill soils. For slabs on grade, we recommend that granular import be placed as soon as the subgrade is prepared to protect the subgrade soil.

The following recommendations are provided for slabs constructed on the unyielding subgrade surface:

1. A four-inch layer of clean crushed rock (3\4" to 1 1/4" clean crushed rock works well) should be placed over the structural fill or prepared subgrade to provide a positive capillary moisture break and uniform slab support.
2. An impermeable membrane, such as 10-mil plastic sheeting, should be placed over the crushed rock layer to further prevent upward migration of moisture vapor into and through the concrete slab, especially for slabs under living space.
3. In order to protect the membrane and provide more uniform curing of the slab, it is advisable to place one to two inches of clean sand on top of the membrane. The sand should be moistened prior to placing concrete.
4. Where insulation is required along the perimeter, the insulation may replace the 2-inch sand layer.

We recommend that the contractor use deformed reinforcing steel for slab reinforcement rather than welded wire fabric. A minimum reinforcement scheme would be #3 or # 4 bars, 18 inches on center, both ways. Fibermesh may be used to help decrease drying shrinkage cracks, however it is not a replacement for structural reinforcing. All slabs tend to crack, therefore jointing at approximately 8 to 10 foot intervals, both directions, should significantly decrease random cracking in the open areas.

5.5.2 Drainage Blanket (Optional)

If seepage at the slab grade appears to be a significant problem, the geotechnical engineer should be consulted to evaluate the site conditions. At that time the engineer might recommend a drainage blanket to help prevent wet slab conditions. The drainage blanket typically consists of a 12 inch zone of clean crushed rock with collection pipes that is placed underneath the slab. This prevents water levels from reaching the level of the slab provided there is an adequate means of discharging the collected water (if it is collected) or that there is a natural drainage path for the water to leave the footing excavation.

5.6 BACKFILL AND COMPACTION

Site soils are not suitable for backfill behind walls or under slabs. Imported fill soils containing less than 7 percent passing the number 200 sieve used as embankment fill, and under slabs should be moisture conditioned to within 3 percent of optimum moisture content, placed in loose, horizontal lifts less than 8 inches in thickness, and compacted to at least 92 percent of the maximum dry density, as determined using ASTM D1557 (Modified Proctor). The 92 percent compaction criteria should apply to any material intended to support pavement or intended as backfill behind walls. In areas not constructed as fill slopes or not intended to support pavement or structures, suitable fill material should be placed in loose lifts less than 12 inches in thickness and compacted to at least 90 percent of the maximum dry density.

If structures or pavement sections are planned to be supported on the structural fill the compaction criteria should be 95 percent of the Modified Proctor. The embankment fill constructed for the roadway should be placed and compacted to the 95 percent standard. The compaction method and placement of the material must be monitored by the geotechnical engineer.

5.7 PERMANENT EROSION CONTROL

Following placement of the embankment fill or retaining wall backfill, installation of the subsurface utilities and drainage system, and completion of the flat work, the site must be permanently stabilized. All exposed soils on site must either be covered with a thick layer of mulch (3 – 4 inches) that is incorporated into the final landscaping plan or vegetated with lawn or other groundcover. Additional requirements for soil amendment may be specified by the landscape designer or to satisfy local requirements.

If the access roadway is supported on embankment fill, the slopes must be amended and planted according to the recommendations provided in the plan. At a minimum the slope face should be amended within the upper 12 inches with at least 3 inches of compost then covered with fertile mulch and planted according to the recommendations of in approved landscape plan.

5.8 DRAINAGE RECOMMENDATIONS

The site appears underlain fairly uniformly by about two to three feet of loose, weathered, silty SAND with organics, blanketing dense silty SAND with gravel or glacial till. The site soils appear too dense below the upper 2 feet of material to adequately infiltrate surface water runoff. There appeared to be a perched groundwater (near surface water) along the contact with the weathered zone and the dense glacial till unit. This might dry out in the summer, but should be expected during most of the year.

We recommend that consideration be given to intercepting this perched near surface water on the uphill side of the units with a cutoff drain or French drain to direct seepage around the building foundations. The collected water could be discharged in a dispersion trench away from the building units or farther down gradient from the building site. Water appeared to be readily absorbed in the upper few feet of soil without erosion on the site in its current condition. We did not observe standing water on the site except down near the existing 12-inch concrete culvert crossing.

The site might provide opportunities for dispersion trenches as a means of dispersing collected stormwater runoff, but all dispersion areas should have means of conveying excessive runoff safely toward the creek. Dispersion trenches should be located no closer than 15 feet from the top of the north facing slope.

6.0 ADDITIONAL SERVICES AND LIMITATIONS

6.1 ADDITIONAL SERVICES

Additional services by the geotechnical engineer are important to help insure that report recommendations are correctly interpreted in final project design and to help verify compliance with project specifications during the construction process. For this project we anticipate additional services may include the following:

1. Review final design and construction drawings for conformance with geotechnical recommendations.
2. Monitor excavations and evaluate need for preserving bearing surfaces.
3. Monitor placement and compaction of imported fill material
4. Provide periodic construction field reports, as requested by the client and required by the building department.

We would provide these additional services on a time-and-expense basis in accordance with our Standard Fee Schedule and General Conditions already in place for this project.

6.2 LIMITATIONS

This geotechnical investigation was planned and conducted in accordance with generally accepted engineering standards practiced presently within this geographic area. Geotechnical investigations performed by these standards reveal with reasonable regularity soils that are representative of subsurface conditions throughout the site under consideration. Recommendations contained in this report are based upon the assumption that soil conditions encountered in explorations are representative of actual conditions throughout the building site. However, inconsistent conditions can occur between exploratory borings or test pits and not be detected by a geotechnical study. If, during construction or subsequent exploration, subsurface or slope conditions are encountered which differ from those anticipated based upon results of this investigation, The Galli Group should be notified so that we can review and revise our recommendations where necessary. If conditions change prior to the proposed construction, we should be consulted so that we may alter our recommendations if necessary.

This report is prepared for the exclusive use of the owner or the owner's consultants for specific application on this project at this particular site. Copies of this report should be made available to the design team, and should be included with the contract drawings issued to the contractor. Our report, conclusions, and interpretations should not be construed as a warranty of the subsurface conditions on the site and should not be applied to neighboring sites. No warranty expressed or implied is made. We recommend that geotechnical observation and testing be provided during the construction phases to verify that the recommendations provided in this report are incorporated into the actual construction.

Respectfully submitted,

THE GALLI GROUP

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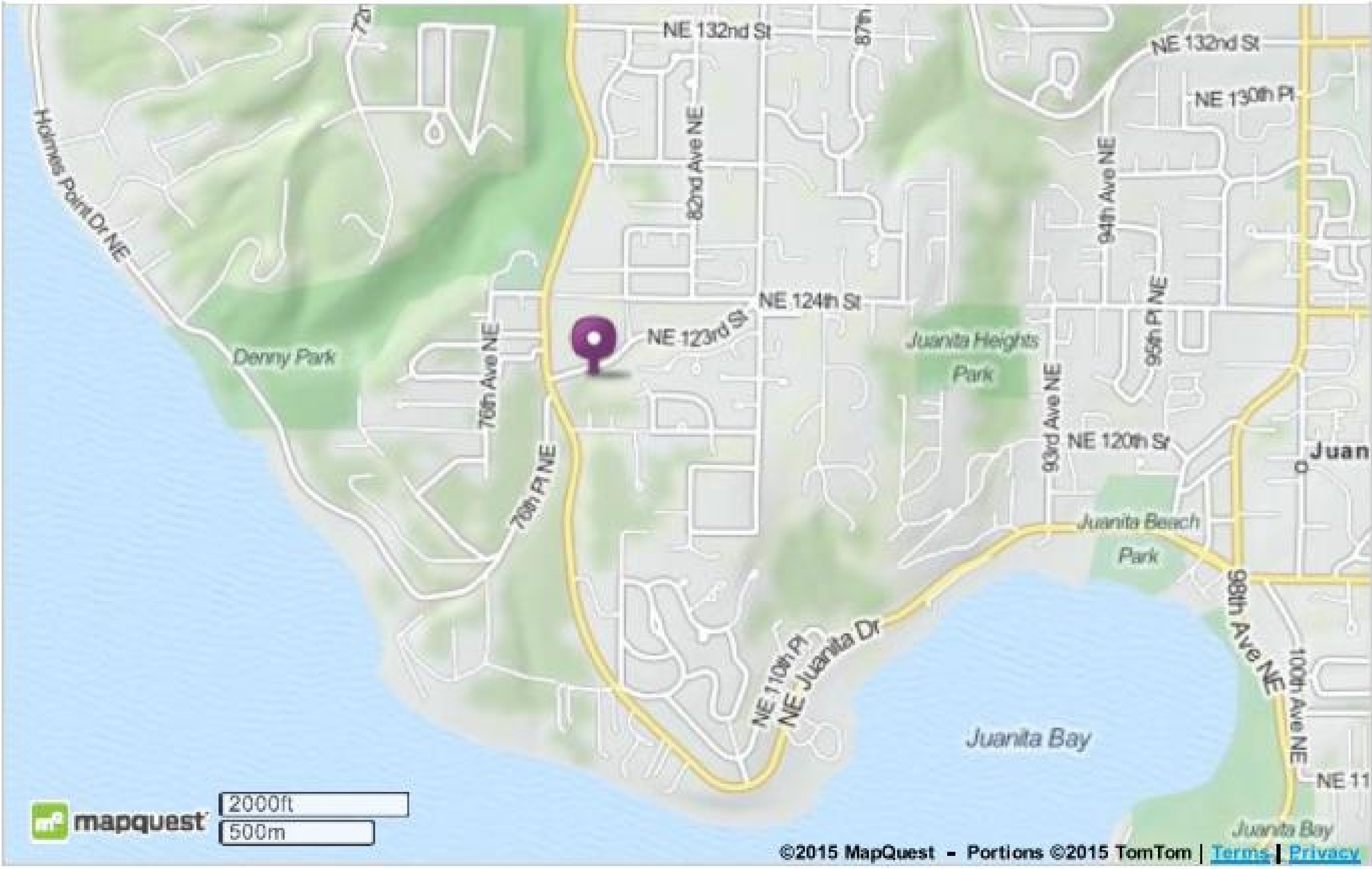
Project Geotechnical Engineer

1-28-2015



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7845 NE 122nd Place
Kirkland, Washington

VICINITY MAP
FIGURE 1

N

W E

S

GRAPHIC SCALE

10 0 10 20 40

1INCH = 20 FT.

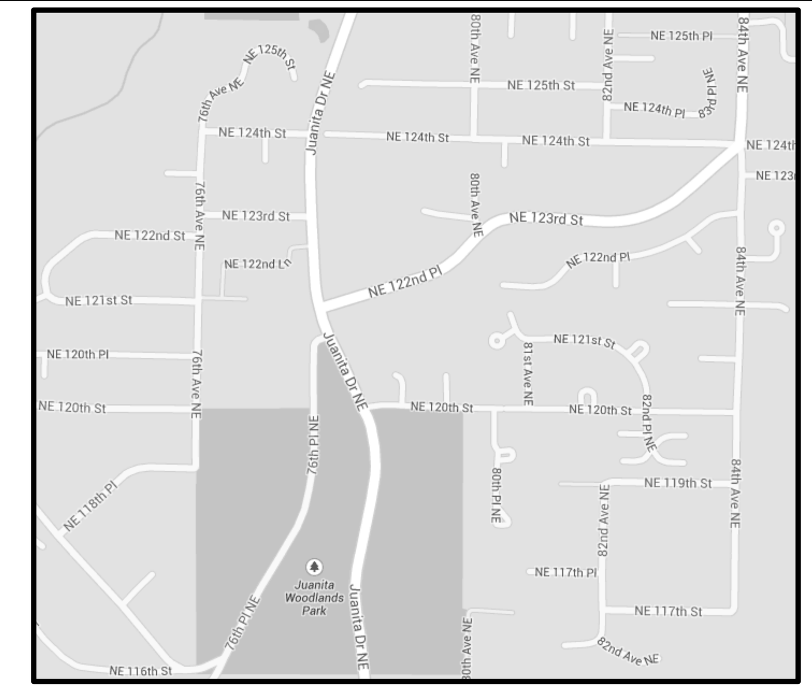
LEGEND

◒	FOUND MONUMENT AS DESCRIBED
○	FOUND PROPERTY CORNER AS DESCRIBED
	LAMP POST
	POWER METER
	UTILITY POLE
	ORDINARY HIGH WATER MARK FLAG
PMT	PAD MOUNTED TRANSFORMER
	STORM DRAIN MANHOLE
	SANITARY SEWER MANHOLE
	WATER VALVE
	FIRE HYDRANT
	WATER METER
	CABLE TV PEDESTAL / JUNCTION BOX
—SS—	APPROXIMATE LOCATION SANITARY SEWER LINE
—SD—	APPROXIMATE LOCATION STORM DRAIN LINE
—OHU—	OVERHEAD UTILITIES
—□—	WOOD FENCE
—X—	CHAIN LINK FENCE
	ASPHALT SURFACE
	CONCRETE SURFACE
	GRAVEL SURFACE
PI	PINE
CE	CEDAR
MP	MAPLE
DF	DOUGLAS FIR
DS	DECIDUOUS

* DENOTES MULTI-TRUNK

PROJECT INFORMATION

SURVEYOR:	SITE SURVEYING, INC. 21923 NE 11TH STREET SAMMAMISH, WA 98074 PHONE: 425.298.4412
PROPERTY OWNER:	GABE THORNQUIST 7845 NE 122ND PLACE KIRKLAND, WA 98034
TAX PARCEL NUMBER:	607650-0421
PROJECT ADDRESS:	7845 NE 122ND PLACE KIRKLAND, WA 98034
ZONING:	RMA 2.4
JURISDICTION:	CITY OF KIRKLAND
PARCEL ACREAGE:	42,028 S.F. (± 0.96 ACRES) AS SURVEYED



VICINITY MAP

NTS

LEGAL DESCRIPTION

LOT A, COUNTY OF KING SHORT SUBDIVISION NO. 682027, AS RECORDED UNDER RECORDING NUMBER 8209070509, RECORDS OF KING COUNTY, WASHINGTON.

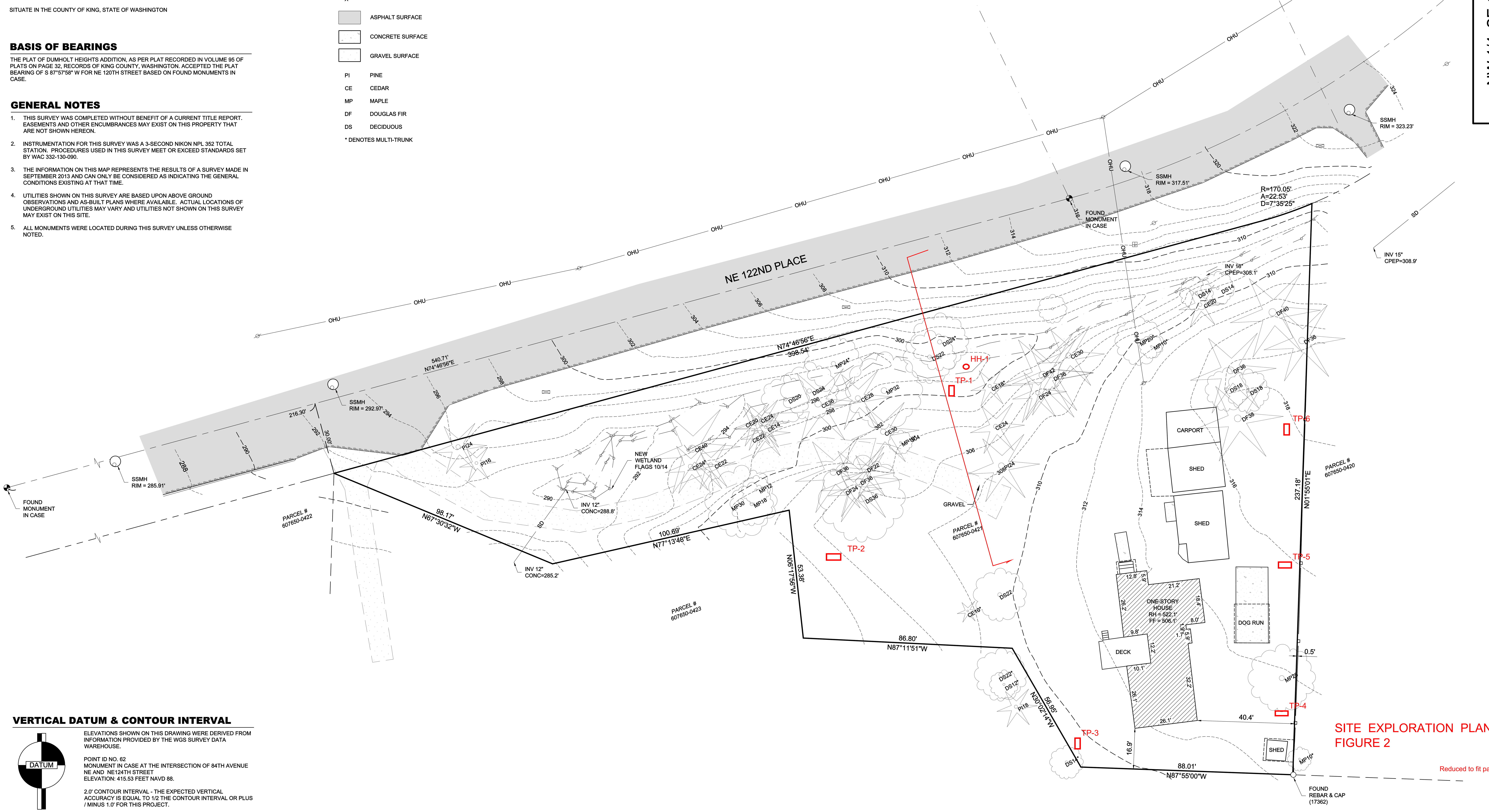
SITUATE IN THE COUNTY OF KING, STATE OF WASHINGTON

BASIS OF BEARINGS

THE PLAT OF DUMHOLT HEIGHTS ADDITION, AS PER PLAT RECORDED IN VOLUME 95 OF PLATS ON PAGE 32, RECORDS OF KING COUNTY, WASHINGTON. ACCEPTED THE PLAT BEARING OF S 87°57'58" W FOR NE 120TH STREET BASED ON FOUND MONUMENTS IN CASE.

GENERAL NOTES

1. THIS SURVEY WAS COMPLETED WITHOUT BENEFIT OF A CURRENT TITLE REPORT. EASEMENTS AND OTHER ENCUMBRANCES MAY EXIST ON THIS PROPERTY THAT ARE NOT SHOWN HEREON.
2. INSTRUMENTATION FOR THIS SURVEY WAS A 3-SECOND NIKON NPL 352 TOTAL STATION. PROCEDURES USED IN THIS SURVEY MEET OR EXCEED STANDARDS SET BY WAC 332-130-090.
3. THE INFORMATION ON THIS MAP REPRESENTS THE RESULTS OF A SURVEY MADE IN SEPTEMBER 2013 AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS EXISTING AT THAT TIME.
4. UTILITIES SHOWN ON THIS SURVEY ARE BASED UPON ABOVE GROUND OBSERVATIONS AND AS-BUILT PLANS WHERE AVAILABLE. ACTUAL LOCATIONS OF UNDERGROUND UTILITIES MAY VARY AND UTILITIES NOT SHOWN ON THIS SURVEY MAY EXIST ON THIS SITE.
5. ALL MONUMENTS WERE LOCATED DURING THIS SURVEY UNLESS OTHERWISE NOTED.



SITE EXPLORATION PLAN
FIGURE 2

Reduced to fit page

VERTICAL DATUM & CONTOUR INTERVAL

DATUM

ELEVATIONS SHOWN ON THIS DRAWING WERE DERIVED FROM INFORMATION PROVIDED BY THE WGS SURVEY DATA WAREHOUSE.

POINT ID NO. 62
MONUMENT IN CASE AT THE INTERSECTION OF 84TH AVENUE NE AND NE124TH STREET
ELEVATION: 415.53 FEET NAVD 88.

2.0' CONTOUR INTERVAL - THE EXPECTED VERTICAL ACCURACY IS EQUAL TO 1/2 THE CONTOUR INTERVAL OR PLUS / MINUS 1.0' FOR THIS PROJECT.

NW 1/4, SE 1/4, SEC 25, TWP 26N, RNG 4E, W.M.

Site Surveying, Inc.
21923 NE 11th Street Sammamish, WA 98074
Phone: 425.298.4412
www.sitesurveymapping.com

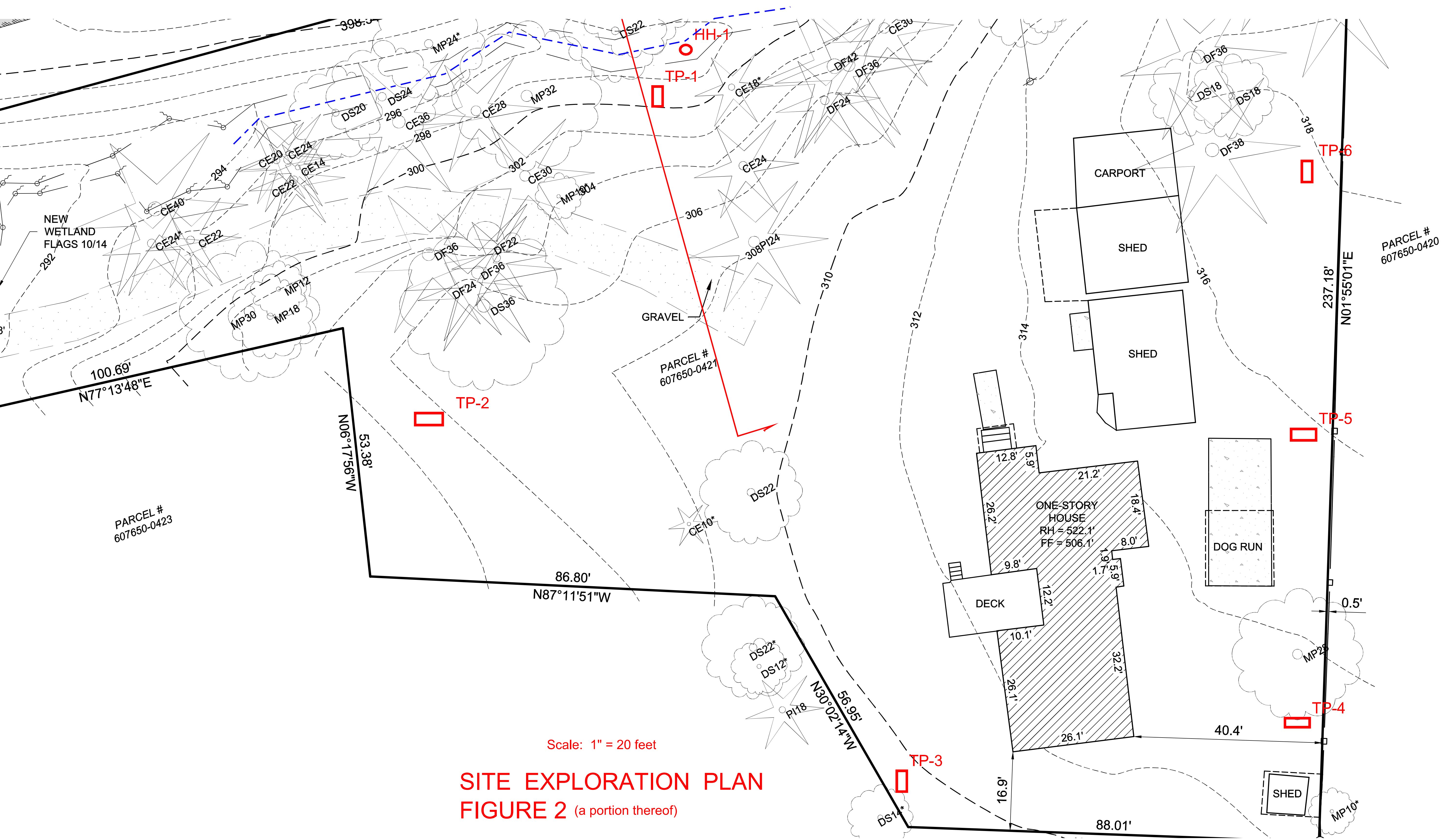
THOMAS N. WOLDENDOR
STATE OF WASHINGTON
REGISTERED PROFESSIONAL LAND SURVEYOR

DATE	REVISION	DRN
10/2/14	EXTRA WETLAND FLAGS ADDED	TNW

TOPOGRAPHIC SURVEY

CHANDLER HOMES
7845 NE 122ND PLACE
KIRKLAND, WA 98034

PROJECT NO.	13-350
DRAWN BY:	EFJ
CHECKED BY:	TNW
DATE:	10/5/14
SHEET	1 OF 1



Scale: 1" = 20 feet

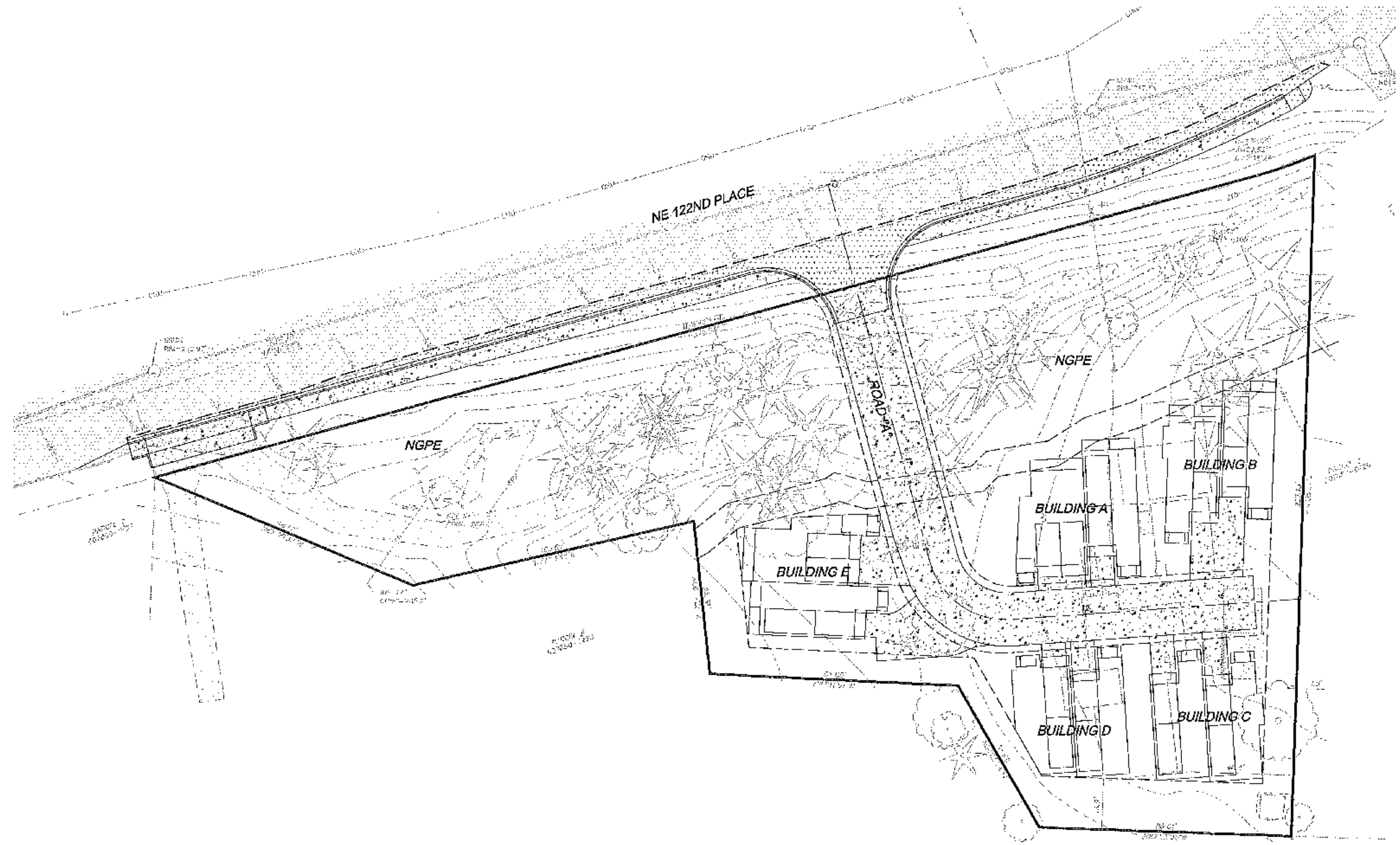
SITE EXPLORATION PLAN

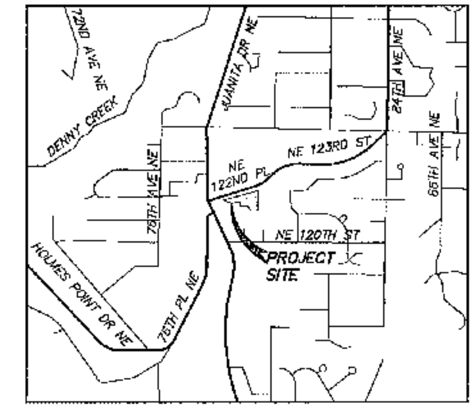
FIGURE 2 (a portion thereof)

SE 1/4 SECTION 25, TOWNSHIP 6 N, RANGE 4 E, W.M.

KIRKLAND COTTAGES

PRELIMINARY ENGINEERING PLANS





VICINITY MAP
SCALE 1"=1000'

LEGEND:

- QUARTER SECTION CORNER AS NOTED
- FOUND MONUMENT AS NOTED
- FOUND CORNER MONUMENT AS NOTED
- 5/8" X 24" REBAR WITH PLASTIC CAP STAMPED "DRS 37555" TO BE SET AT FINAL SHORT PLAT
- POWER POLE
- WATER VALVE
- SDCB — CATCH BASIN
- SSMH — SANITARY SEWER MANHOLE
- GAS VALVE
- GAS METER
- MB — MAILBOX
- DECIDUOUS TREE
- EVERGREEN TREE
- BWF — BARB WIRE FENCE
- HWF — HOG WIRE FENCE
- HWFP — HOG WIRE FENCE POST
- VBF — VERTICAL BOARD FENCE
- WF — WIRE FENCE
- WFP — WIRE FENCE POST
- FENCE LINE
- SANITARY SEWER LINE
- STORM LINE
- OP — OVERHEAD POWER
- P — POWER PAINT
- G — GAS PAINT
- EDGE OF PAVEMENT

SHEET INDEX:

PROJECT CONTACTS

APPLICANT: CHANDLER HOMES, LLC
10220 NE 110TH STREET
KIRKLAND, WA 98033
(425) 466-7299
CONTACT: MARK PUTZKE
EMAIL: MARK1PUTSTORAGE@GMAIL.COM

PROJECT ENGINEER/PLANNER: D.R. STRONG CONSULTING ENGINEERS
620 7TH AVENUE KIRKLAND, WA 98033
(425) 827-3063
CONTACT: LUAY JOUDEH, P.E.
EMAIL: LUAY.JOUDEH@DRSTRONG.COM

PROJECT ARCHITECT: BOHAC ARCHITECTURE, PLLC
P.O. BOX 812
BELLEVUE, WA 98009-0812
(206) 310-4534
CONTACT: BART BOHAC
EMAIL: BART@BOHACARCH.COM

NOTES:

1. SITE PLAN AS PROVIDED BY ARCHITECT.
2. TOPOGRAPHIC AND BOUNDARY SURVEY AS PROVIDED BY SITE SURVEY & MAPPING, INC.
3. THIS PLAN SET IS PREPARED FOR PRELIMINARY REVIEW BY CITY STAFF THE PLANS ARE NOT INTENDED FOR CONSTRUCTION.

PROJECT DESCRIPTION:

ADDRESS OF THE PROPERTY:	7845 NE 122ND PLACE
PARCEL NUMBERS:	6076500421
EXISTING ZONING:	RMA-2.4, HIGH DENSITY RESIDENTIAL
PROPOSED DWELLING UNITS:	10
ACREAGE:	1.07 ACRES (46,754 S.F.) GROSS
R.O.W. AREA:	EXISTING R.O.W.
PROPOSED USE:	MULTI FAMILY HOUSING
SEWER DISTRICT:	N.U.D.
WATER DISTRICT:	N.U.D.
SCHOOL DISTRICT:	LAKE WASHINGTON NO. 414
TELEPHONE SERVICE:	FRONTIER
POWER SOURCE:	PUGET SOUND ENERGY

LEGAL DESCRIPTION: (BY SITE SURVEYING INC.)

LOT A, COUNTY OF KING SHORT SUBDIVISION NO. 682027, AS RECORDED UNDER RECORDING NUMBER 8209070509, RECORDS OF KING COUNTY, WASHINGTON.

SITUATE IN THE COUNTY OF KING, STATE OF WASHINGTON

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ALL MONUMENTS WERE LOCATED DURING THIS SURVEY UNLESS OTHERWISE NOTED.

VERTICAL DATUM & CONTOUR INTERVAL (BY SITE SURVEYING INC.)

DATUM

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2.0' CONTOUR INTERVAL – THE EXPECTED VERTICAL ACCURACY IS EQUAL TO 1/2 THE CONTOUR INTERVAL OR PLUS / MINUS 1.0' FOR THIS PROJECT.

PRELIMINARY SITE PLAN
FIGURE 3

NORTH

GRAPHIC SCALE
1 INCH = 20 FT.

Call 2 Working Days Before You Dig
811
Utilities Underground Location Center

D.R. STRONG
CONSULTING ENGINEERS
ENGINEERS PLANNERS SURVEYORS
620 - 7th AVENUE KIRKLAND, WA 98033
O 425.827.3063 F 425.827.2423

KIRKLAND COTTAGES
10 UNIT TOWNHOMES
PRELIMINARY ENGINEERING DESIGN
COVER SHEET
7845 NE 122ND PLACE
KIRKLAND, WASHINGTON

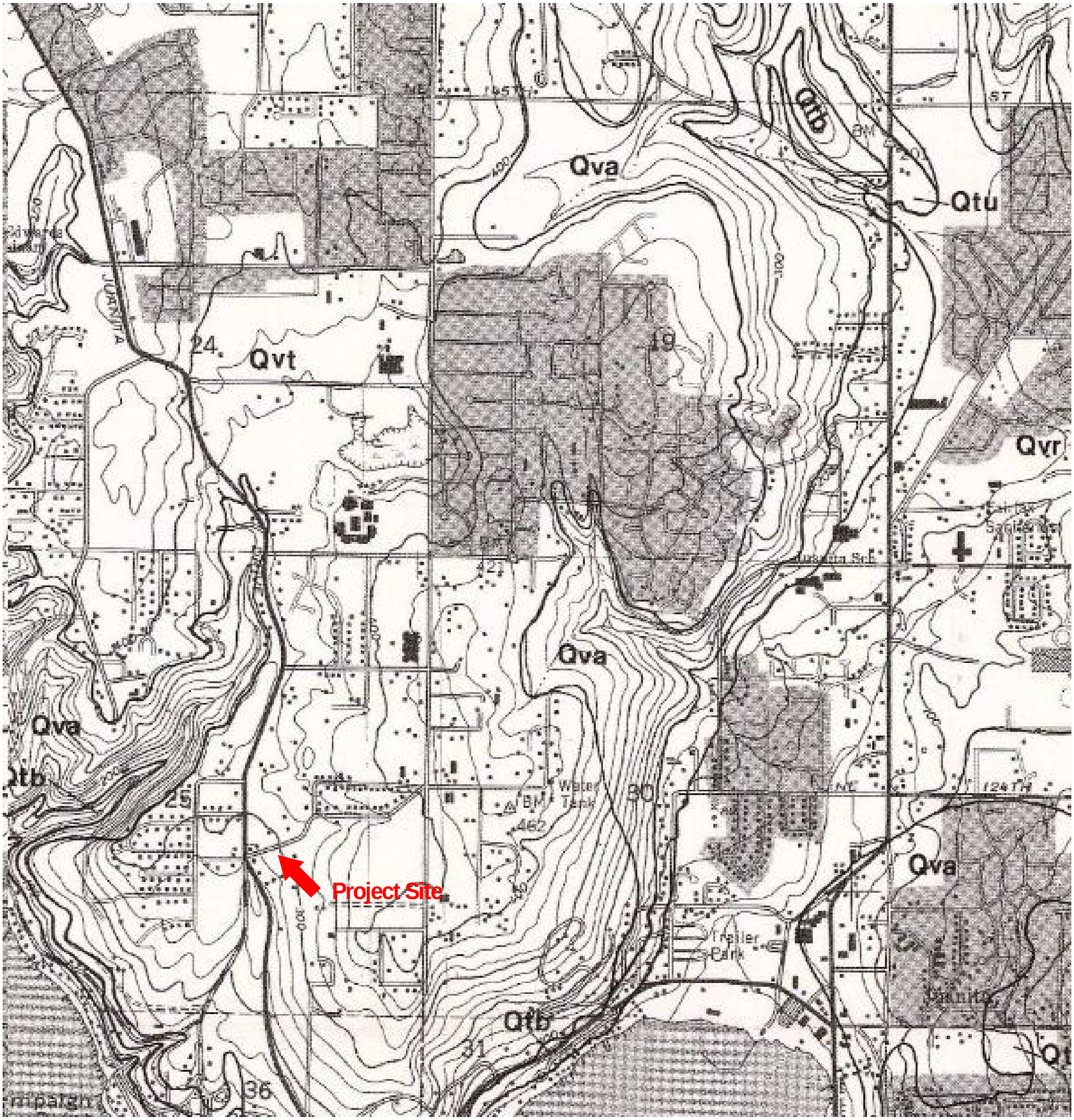
CHANDLER HOMES, LLC
10220 NE 110TH STREET
KIRKLAND, WA 98033
425.466.7299

LUAY H. JOUDEH
STATE OF WASHINGTON
PROFESSIONAL ENGINEER

DATE | REVISION | APR

DRAFTED BY: CWA
DESIGNED BY: LRJ
PROJECT ENGINEER: LRJ
DATE: 08.12.14
PROJECT NO.: 14059

DRAWING: C1
SHEET: 1 OF 8



Ref: Geologic Map of the
Kirkland Quadrangle, Washington,
Minard 1983

LEGEND

Qvt	Glacial Till
Qva	Advance Outwash
Qtb	Transitional Beds

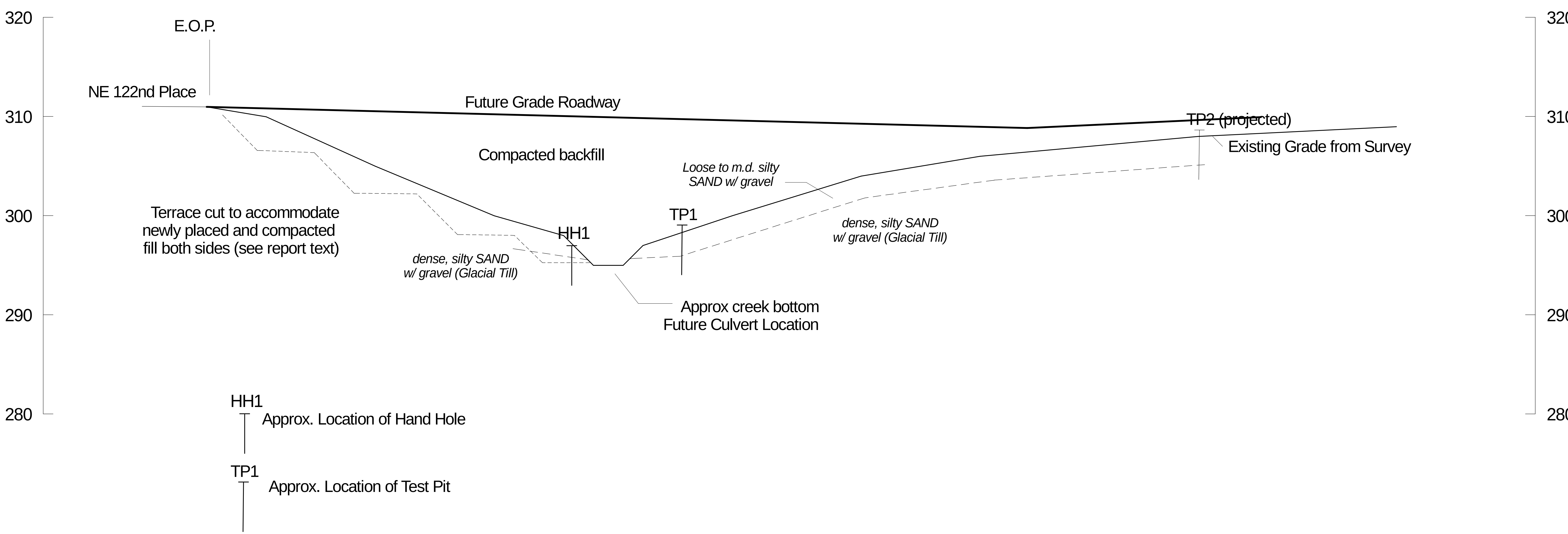
The Galli Group
PO Box 30759
Seattle, WA 98113

7845 NE 122nd Place
Kirkland, Washington

GEOLOGIC MAP
Figure 4

Section A-A'

Scale: 1" = 10 feet



The Galli Group
PO Box 30759
Seattle, WA 98113

7845 NE 122nd Place
Kirkland, Washington

CROSS SECTION
Figure 5

Appendix

Logs of Exploratory Test Pits

Appendix A: Logs of Exploratory Borings and Test Pits

Unified Soil Classification System; from American Society for Testing and Materials

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO.200 SIEVE	GRAVEL MORE THAN 50% OF COARSE FRACTION RETAINED ON NO.4 SIEVE	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50% OF COARSE FRACTION PASSES NO.4 SIEVE	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS MORE THAN 50% PASSES NO.200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY LIQUID LIMIT 50 OR MORE	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

FOR SAND AND GRAVELS

DENSITY	STANDARD PENETRATION RESISTANCE (SPT) BLOWS/FT.
VERY LOOSE	0 – 4
LOOSE	4 – 10
MEDIUM DENSE	10 – 30
DENSE	30 – 50
VERY DENSE	> 50

FOR SILTS AND CLAYS

CONSISTENCY	STANDARD PENETRATION RESISTANCE (SPT) BLOWS/FT.
VERY SOFT	0 – 2
SOFT	2 - 4
MEDIUM STIFF	4 – 8
STIFF	8 - 16
VERY STIFF	16 – 32
HARD	> 32

Logs of Exploratory Test Holes

1-23-2015

7845 NE 122nd Place
Kirkland, Washington

TP-1 S side of Creek
Elev. 252 (48" above creek)

Depth	Description
00' – 24"	Loose, dk. brown, organic rich silty SAND w/ gravel (TOPSOIL/DUFF)
24" – 38"	Loose to m.d., red-brown, silty SAND with gravel; wthrd streaks throughout; moist to wet -slight seepage on uphill side at bottom of layer; causes minor caving near seepage
38" – 50"	Dense, gray silty SAND with gravel; moist -cobbles at 60" -no seepage on creek side

TP-2 South of existing driveway
Elev. 306 (Elevation from survey)

Depth	Description
00' – 15"	Loose, dk. brown, organic rich silty SAND w/ gravel (TOPSOIL/FILL)
15" – 40"	Loose to m.d., red-brown, weathered silty SAND with gravel; moist to wet -no seepage observed
40" – 54"	Dense, gray silty SAND with gravel; moist

TP-3 28'W 8' S of SW cor house
Elev. 310 (Elevation from survey)

Depth	Description
00' – 10"	Loose, dk. brown, organic rich silty SAND w/ gravel (TOPSOIL)
10" – 36"	Loose to m.d., red-brown, weathered silty SAND with gravel; wet -rapid seepage at 24" depth; 4-5 gpm first 5 min.; 0.5 gpm fm 5-50 min.
36" – 40"	Dense, gray silty SAND with gravel; moist

TP-4 6' N shed, 5' W of fence
Elev. 313 (Elevation from survey)

Depth	Description
00' – 12"	Loose, brown silty SAND (FILL)
12" – 22"	Loose, dk. brown, organic rich silty SAND w/ gravel (TOPSOIL)
22" – 34"	Loose to m.d., red-brown, weathered silty SAND with gravel; wet -rapid seepage at 24" depth; < 2 gpm
36" – 40"	Dense, gray silty SAND with gravel; moist

Logs of Test Pits

1-23-2015

7845 NE 122nd Place
Kirkland, Washington

TP-5 Opp NE cor House, 5’ fm fence
Elev. 316 (Elevation from survey)

Depth	Description
00’ – 12”	Loose, dk. brown, organic rich silty SAND w/ gravel (TOPSOIL)
12” – 20”	Loose to m.d., red-brown, weathered silty SAND with gravel; wet
	-moderate seepage at 20” depth; <1gpm
20” – 36”	Dense, gray silty SAND with gravel; moist

TP-6 8’ W fence, Opp N side shed
Elev. 318 (Elevation from survey)

Depth	Description
00’ – 9”	Loose, dk. brown, organic rich silty SAND w/ gravel (TOPSOIL)
9” – 29”	Loose to m.d., red-brown, weathered silty SAND with gravel; moist
	-no seepage
29” – 34”	Dense, gray silty SAND with gravel; moist

HH-1 North side of Creek
Elev. 297 (Elevation from survey)

Depth	Description
00’ – 24”	Loose, dk. brown, organic rich silty SAND w/ gravel (DUFF/TOPSOIL)
24” – 36”	Loose to m.d., red-brown, weathered silty SAND with gravel; wet
	-moderate seepage at 30” depth; <1gpm
36” – 38”	Dense, gray silty SAND with gravel; contains cobbles; moist

Logs of Exploratory Test Holes

7845 NE 122nd Place
Kirkland, Washington

FIELD OBSERVATIONS:

Site soil characteristics appeared fairly consistent throughout on upland area. Test pits revealed dense, gray silty SAND with gravel at a depth of about 2 to 3 feet, mantled by weathered silty SAND, often with seepage at contact with underlying layer. Some soil has been moved around on site with fill observed west of proposed entrance road (TP2) and near southernmost portions of the lot (TP3 and TP4). We interpreted the underlying soil as glacial till.

Seepage was visible at contact between weathered zone and dense underlying gray silty SAND. We interpreted this as perched near surface water flow from rainfall and topographic collection of surface runoff.

At location of proposed culvert the dense silty SAND was evident at about the same grade as the bottom of the creek/drainage. Seepage was evident on the uphill sides of the test pit along the contact between the weathered zone and dense gray till layer. Good foundation support available. Might need pumping of footing excavations. Only minimal incision into the glacial till from creek. About 12-18 inches of till observed in sidewall of creek bed.

Site might contain abandoned septic drainfield, likely in uppermost 3 feet of soil. Contractor should be aware of this and establish footings below disturbed soil.

Site soils will not be suitable for compaction except during dry summer months and should not be used for structural fill or in drainage zones.